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STRUCTURE AND DEVELOPMENT OF DRUPE IN *RAUVOLFIA TETRAPHYLLA* L.

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ABSTRACT

Drupaceous fruit of *Rauvolfia* develops from a bicarpellary, syncarpous superior ovary. Lower half of the ovary shows incomplete fusion upto middle, while towards the terminal part both the carpels fuse completely. Fruit wall is structurally differentiated into single layered epicarp, fleshy mesocarp and stony endocarp. Laticifers are of non-articulated type with milky latex.

INTRODUCTION

Rauvolfia tetraphylla plants drew maximum attention due to the occurrence of medicinally important alkaloids in its various organs. A series of anatomical as well as phytochemical studies (Banerjee and Sharma, 1983) have been performed on this plant, but its fruit has remained highly neglected for the development and structural study. The genus *Rauvolfia* is the only member belonging to the family Apocynaceae having a drupaceous fruit, developing from a bicarpellary syncarpous superior ovary. Usually, a drupe develops from a monocarpellary pistil (King 1938, Roth 1977, von Teichman 1987). But in *Coffea* (Roth & Lindorf 1971) the development of drupe is from an inferior ovary composed of two carpels. Lamba and Gupta (1977) have briefly described the morphology and anatomy of the drupe of *R. serpentina*. The present article incorporates a detailed structural and complete developmental anatomy of the pericarp of *R. tetraphylla* fruit.

MATERIALS AND METHODS

Different developmental stages of ovary and fruits were collected from the University Botanical Garden and fixed in F.A.A., after sorting out as shown in the table given below. Fixed materials were processed for paraffin sectioning after the dehydration through a graded series of T.B.A. (Sass 1958). Serial sections of 6-8μm were cut and stained with safranin-fast green for general histology. Observations and photomicrographs were taken with Carl-Zeiss microscopes.

Sl. No.	Average length in cm	Average breadth in cm	Remarks
1	0.15	0.15	Ovary from open flower
2	0.3	0.3 :	
3	0.6	0.7 :	Developing fruit
4	0.8	1.0	Mature fruit

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OBSERVATIONS

The fruit of *Rauvolfia tetraphylla* is a small glabrous drupe (Fig. 1) developing from a bicarpellary syncarpous superior ovary with ovules on its axile placenta (Fig. 2). At the extreme base, both the carpels are almost free (Figs. 3, 4, 5). But towards the upper half of the ovary, both the carpels are completely fused. Ovary wall is homogenous parenchymatous differentiated into outer epidermis, mesodermis and inner epidermis (Fig. 6).

Outer epidermis is the outermost layer of the ovary wall; which is single layered and constituted of radially elongated or rectangular cells (Fig. 6) with deeply stained cytoplasm and prominent spherical nuclei. Cells show frequent anticlinal divisions. Stomata and trichomes are totally absent on the outer epidermis. A thin cuticle covers the outer tangential wall. Mesodermis is 10 - 12-layered, with loosely arranged parenchyma cells. There are 12-14 conjoint, collateral vascular bundles arranged in a ring, and are highly differentiated. Laticifers are of non-articulated type, found adjacent to the vasculature. Inner epidermis is single layered. Cells are tangentially elongated. Inner epidermis is astomatic and atrichomatous. Septa is 12 - 15-layered and highly vascularized. Fusion of carpels in the lower half of the ovary is incomplete, but in the upper half fusion is complete.

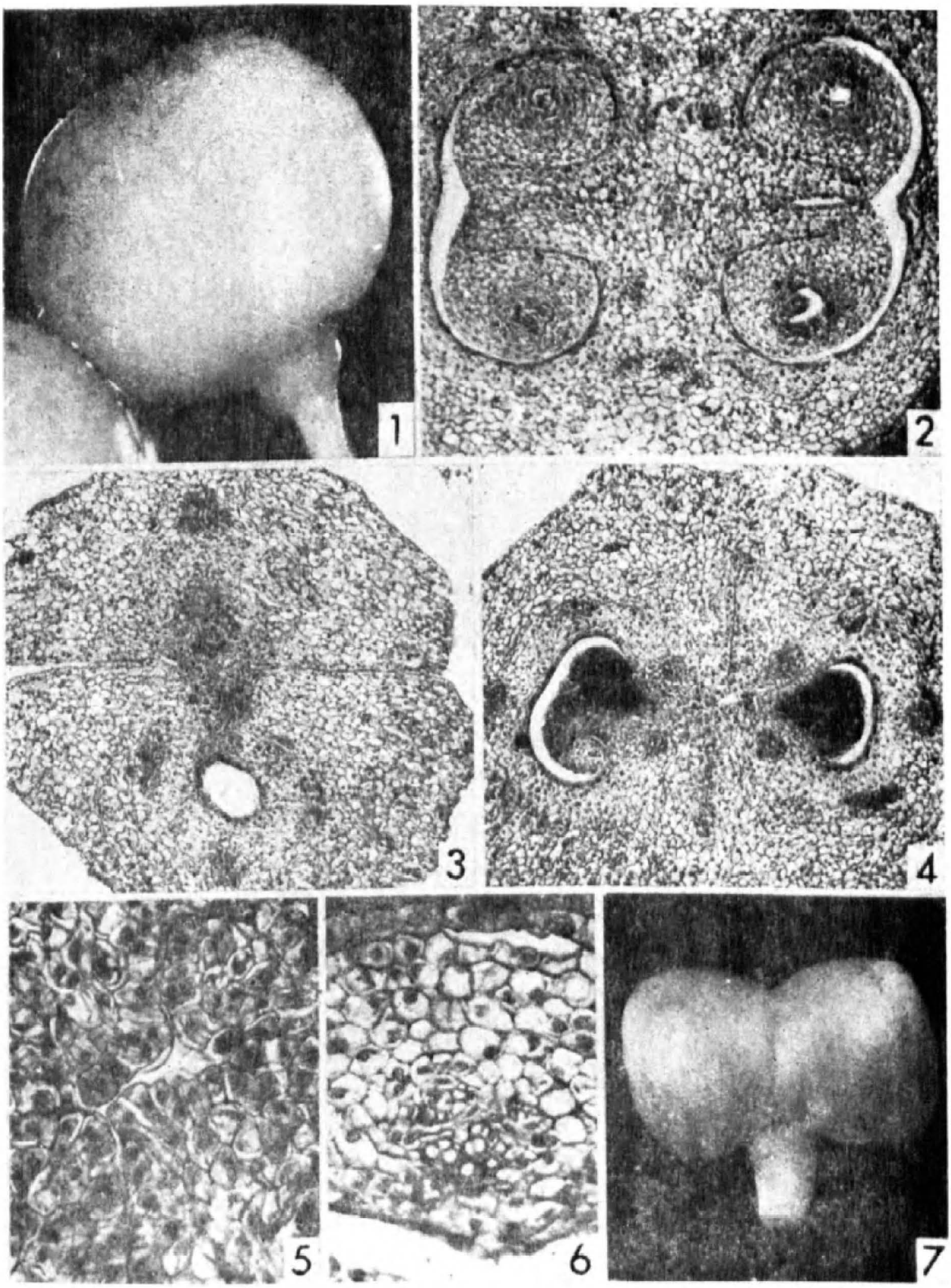
Development of the fruit is initiated after anthesis, to become a drupe (Fig. 1). But rarely both the carpels separate incompletely and develop into a twin drupe (Fig. 7). Ovary wall develops into pericarp with three distinct parts : epicarp, mesocarp and endocarp (Figs. 14, 15).

Epicarp is single layered (Figs. 8, 9, 15) developing from the outer epidermis of the ovary wall. In young fruit, epicarpic cells are radially elongated due to frequent anticlinal divisions. Cells have deeply stained cytoplasm with nuclei at the centre (Figs. 8, 9). Stomata and hairs appear on the fruit surface from the 2nd stage onwards of the fruit development. Stomata are of anomocytic type with 3-5 subsidiary cells. Small unicellular unbranched hairs are present throughout the fruit surface (Figs. 9, 10). As the development proceeds cells become highly vacuolated and the nuclei disintegrated. A thick cuticle covers the epicarp.

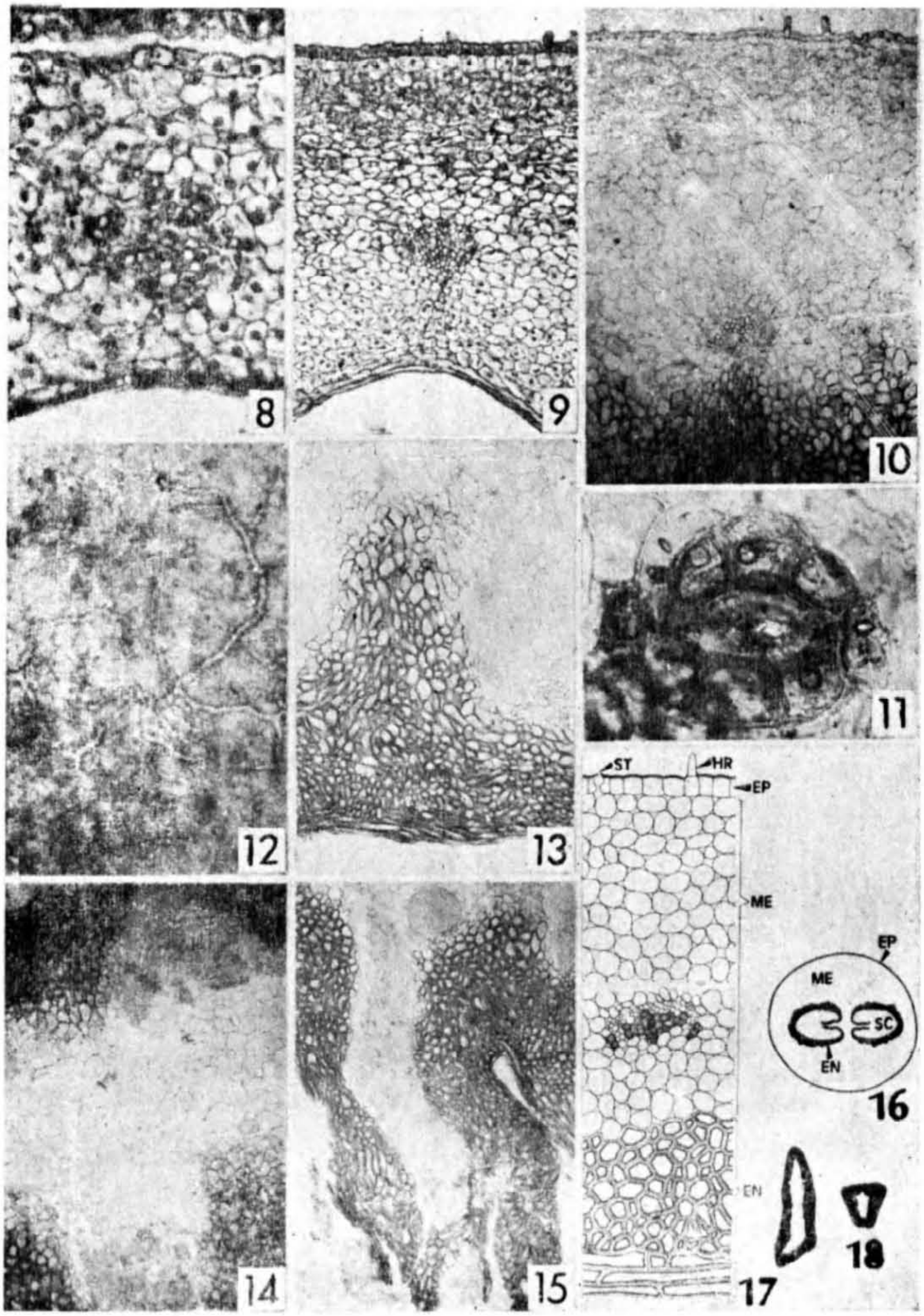
Mesocarp is 12 - 15-layered thick in the early stages of fruit development. Cytoplasm stains deeply and nuclei can be seen at the centre or nearer to the lateral walls (Figs. 8, 9). Vascular bundles are arranged more or less in a ring and are highly differentiated (Figs. 8, 9). Towards the maturity of the fruit, cells enlarge considerably and are highly vacuolated. Mature mesocarp is 50 -60-layered thick. Laticifers are of non-articulated type with milky latex. Tanniniferous cells or crystals are totally absent in this fruit.

Development of the endocarp is from the inner epidermis of the ovary wall. In the early stages of fruit development, endocarp is 1 - 2-layered (Figs. 8, 9). Towards the maturity of fruit, the endocarp becomes multilayered due to the transformation of few mesocarpic cells into lignified cells to add with the endocarp (Fig. 15). Scleriefied endocarp appears wavy (Fig. 11) due to a considerable variation in the number of mesocarpic cells contributed for endocarp formation. Innermost 3-4 layers of cells are tangentially elongated, while the rest of the cells are rectangular or polygonal. Endocarpic sclereids are immensely pitted (Fig. 16).

Septum in the mature fruit is 40 - 50-layered thick and on either sides are bounded by multilayered sclereids which are seen in continuation of the endocarp (Fig. 12). Vascular bundles in the septa are highly differentiated. On either side of the placenta also cells are sclereified (Figs. 13, 14). Each locule possesses one seed, devoid of coma,



Figs. 1-7: 1. Mature drupaceous fruit × 25. 2. Transection of upper half of the ovary showing septa, placenta and ovules × 80. 3, 4, 5. Transection of the lower half of the ovary showing incomplete fusion of the carpel (arrows) × 80 ; × 80 ; × 196. 6. T.S. of ovary wall showing outer epidermis, mesodermis and inner epidermis × 210. 7. A twin drupe × 22,



Figs. 8-18: 8, 9. T.S. of young and developing pericarp showing epicarp, mesocarp and endocarp × 160 ; × 132. 10. T.S. of mature fruit wall × 96. 11.. Endocarp with uneven thickness × 96. 12, 13. Either sides of the septa and placenta are bounded by sclereified cells × 140 ; × 136. 14, 15. Transection of mature drupe showing different tissue zones × 140 ; × 136. 16, 17, 18. Endocarpic sclereids × 140.

DISCUSSION

Bitter (1911) regarded the drupe as the most primitive fruit type. But according to Roth (1977) drupe represents a highly evolved fruit type, originating from a single carpel with dorsiventral symmetry. The development of the drupe in *Rauvolfia* is from a bicarpellary syncarpous, superior ovary with ovules on axile placenta. According to Fallen (1985) congenital syncarpy is common in the sub-family Rauvolfiae. It is found that in the lower half of the ovary of *Rauvolfia*, both the carpels are almost free, but towards the upper half, carpels are united completely. A tendency for one carpel to abort during development has been reported for the genera of the tribes *Rauvolfieae* and *Cerbereae* by Rao (1956) and Fallen (1983). In *Cerbera* the drupe develops from a single carpel, while the other carpel is aborted (Thomas 1989). Development of drupe in *Olea* (*see* Roth 1977) is from a superior ovary with two carpels, but one of them degenerates. Degeneration of carpel during drupe development is also noticed in *Cocos* (*see* Roth 1977). Formation of a twin fruit in *Rauvolfia* may be a step for abortion of a carpel.

Anatomically the drupes of both *R. serpentina* (Lamba and Gupta, 1979) and *R. tetraphylla* are almost the same. Fruit wall is distinguished into epicarp, mesocarp and endocarp. Epicarp is single layered developing from the outer epidermis of the ovary wall. Epicarp possesses stomata and hairs. Mesocarp is fleshy, embedding laticifers and vasculature. As found in the drupes of *Lannea* (von Teichman 1987) tannin cells are absent in *Rauvolfia*.

The endocarp, which can be considered most characteristic part of the drupe, is very heterogenous in its origin and differentiation (Roth 1977). Several sub-epidermal layers are involved in the formation of the kernel of drupe and thus, the endocarp *sensu lato* may comprise the inner epidermis together with some of the underlying tissue (Roth 1977). In *Rauvolfia*, endocarp develops from both inner epidermal cells and mesocarpic cells. Gupta and Lamba (1981) observed brachysclereids, macrosclereids, filiform sclereids and fusiform sclereids in the endocarp of *Rauvolfia*.

ABBREVIATIONS IN FIGS: 16—18.

EN — endocarp ; EP — epicarp ; IE — inner epidermis ; ME — mesocarp ; MS — mesodermis ; OE — outer epidermis ; OV — ovule ; PL — placenta ; SP — septa ; VB — vascular bundle.

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